

DSN Research and Technology Support

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The activities of the Development Support Group in operating and maintaining the Venus Deep Space Station (DSS 13) and the Microwave Test Facility are discussed and summarized and progress noted during the period December 16, 1974 through February 15, 1975. Major activities include preparation for a planned "automated station" demonstration and hardware/software testing therefor, observations of rotation constancy of various pulsars, continued collection of Faraday rotation data with which to effect correction of spacecraft data for Earth's ionosphere effects, solar energy instrumentation data collection activities, 400-kW X-band radar, Block IV receiver/exciter testing at DSS 14, and testing for electromagnetic compatibility with the proposed Goldstone surveillance radar. Extensive DSN 100-kW klystron testing, routine clock synchronization transmissions, and radio science support activities are also reported.

During the two-month period ending February 15, 1975, the Development Support Group, in operating the Venus Deep Space Station (DSS 13) and the Microwave Test Facility (MTF), made progress on various programs as discussed below. To meet budgetary limitations, the contractor staffing of the Development Support Group was reduced from 16 to 10 and the operating hours of the Venus Station from 80 to 40 hours per week, both actions effective on February 3, 1975.

I. In Support of Section 331

A. Station Automation

In support of the station automation program (RTOP 68—Station Monitoring and Control Technology), which will demonstrate an automated station by performing a pulsar track under complete, remote, computer control at DSS 13, we provided 62-3/4 hours of testing. The software for on-site operation is essentially complete, and the

intercommunications among the computers is complete and functioning. Pulsar observations, complete with data collection, are being done under control of the master computer (the SDS-930 at the Venus Station) during these tests.

B. Pulsar Observations

In support of Pulsar Rotation Constancy (OSS-188-41-52-09), we provided 64-1/2 hours of pulsar observations, during which the pulsars tabulated in Table 1 were observed, and precise pulse-to-pulse timing, pulse shape, and pulse power content were measured. These observations, which use the 26-m antenna and SDS-930 computer for data collection, were made at 2388 MHz, using left-circular polarization (LCP).

II. In Support of Section 333

A. Faraday Rotation Data Collection

Observing Applications Technology Satellite Number 1 (ATS-1) at 137.25 MHz, two complete receiving systems record the angle the received electric field vector makes with the horizon. The data are recorded onto an analog chart recorder, a digital printer, and punched paper tape for later computer processing at JPL. The data are mailed to JPL at the end of each day's observations, and, after processing, are used to correct observed spacecraft doppler and range data for the effects of passing through the Earth's ionosphere. These data are collected automatically 24 hours/day, 7 days/week.

B. Sky Survey/NAR Reliability Testing

Using the 26-m antenna, the station receiver, and the Noise Adding Radiometer (NAR), data are automatically collected at night and during weekend hours when the station is unmanned. The antenna is fixed in position at 180-deg azimuth, and observations are made at several fixed elevation positions. During this period, observations were made for a total of 613-1/4 hours, at elevation angles of 80.6 through 81.9 deg, at a frequency of 2295 MHz, right-circular polarization (RCP).

C. Radio Star Calibration

As part of the Antenna Gain Standardization Program, observations are made at DSS 13 to determine received flux density of a number of radio sources. These observations, at 2278.5 MHz, RCP, were made of radio sources Cygnus A, Virgo A, and 3C123, using the 26-m antenna, the station receiver, and the NAR. The NAR has control of the antenna offsets and provides a semi-automated data collection cycle, as well as recording the data.

D. Solar Energy Instrumentation

In support of RTOP 69—Tracking Station Operations Technology, the Solar Energy Instrumentation Data Acquisition System (SEIDAS), which was relocated from DSS 14 to DSS 13, has had additional sensors added. SEIDAS currently has two pyrheliometers and three pyranometers, as well as sensors which measure air temperature, dew point, pressure, and wind speed. The data are recorded onto magnetic tape for later processing by the 1108 computer at JPL.

III. In Support of Section 335

A. Microwave Power Transmission

In preparation for testing of the final array of "rectennas," additional cable pairs were extended from the collimation tower to the operations building (G-51). (These pairs formerly terminated at building G-63.) Additionally, at the collimation tower, a three-phase, 100-ampere ground fault interrupter (GFI) was installed to increase personnel protection.

In preparation for the modifications necessary to the structure of the collimation tower, several prospective contractors visited the facility. At the end of the reporting period, the contract was awarded to Plas-Tal Corporation of Sante Fe Springs, California; they visited the site to make final measurements preparatory to fabricating the necessary steel.

B. X-Band Radar

With continued maintenance and operations support from us, the X-band radar was used to successfully obtain returns from the rings around the planet Saturn, as well as the minor planet Eros, when it came close to Earth in January 1975. The ring observations were made at a power output of 150 kW per klystron (two klystrons installed), but for the Eros observations the power output was successfully raised to 200 kW per klystron.

A variable load was fabricated to test the traveling-wave tube (TWT) power supplies; one of the Logimetrics power supplies failed during test. The other Logimetrics power supply is installed and powering the Varian TWT. The helix drivers have also been installed, and the system is functioning well although some temporary equipment still remains.

C. DSS 14 Block IV Receiver/Exciter

In support of the implementation of the Block IV receiver/exciter at DSS 14 for use during the Viking mission, we aided in the installation and testing of the

receiver and exciter control panels, interface testing, and various troubleshooting. Also, using a test facility setup at DSS 13, we modified, repaired as necessary, and tested various modules for the system using newly generated test procedures with which to measure performance. Although some monitoring and other interface functions are still undergoing test, the Block IV receiver/exciter at DSS 14 is functioning well.

D. Goldstone Surveillance Radar

With the higher intensities of non-ionizing radiation now being emitted by the Goldstone antennas, a way to avoid accidental irradiation of aircraft which may fly into the dangerous part of the antenna beam is desirable. As part of the planning for the possible installation of a short-range surveillance radar, we made measurements of the possible interference between such a radar and the normal DSN operations of spacecraft reception.

Using an FPS-18 type radar as a baseline, measurements were made at DSS 14 using a simulated radar operating at 2835 MHz. Appropriate pulsed signals having a peak level of -10 dBm were coupled into the maser, and their effect upon the demodulation of telemetry was examined. With the station demodulating telemetry with a signal-to-noise ratio (SNR) of 3.6 dB, no difference in the computer's estimation of SNR could be detected between the radar on/radar off configuration. However, this telemetry test was only of short duration and a longer test at higher powers is planned. Examination of the RF performance of the receiver and monitoring system was also performed during the 10-hour test period.

E. DSN Klystron Testing (100 kW)

In support of the implementation of the 100-kW transmitters into DSS 43/63, extensive testing of the X-3060 klystrons to be employed has been conducted at DSS 13. These klystrons have been modified by Varian Associates, the manufacturer, and incorporate a new cathode design.

Although some difficulty has been experienced with klystron dimensional variations that affect both body current and installation into the socket tank, complete parameter testing and a 12-hour "stability" run at 100-kW output power have been completed on klystron serial numbers A6-17-R2, H5-30-R2, K5-24-R1, and L5-34-R1.

IV. In Support of Section 391

Differential VLBI

In support of the Differential VLBI Experiment (OTDA 310-10-60-56), DSS 13, in conjunction with DSS 63, provided 8-1/4 hours of station support. During an actual 5-1/4 hours of observation, 28 radio sources were observed with a new source being selected every 12 minutes. Observations were made at 2290 MHz, using the 26-m antenna adjusted to receive RCP. The data were recorded on a special recorder installed for this experiment.

V. In Support of Section 422

A. Clock Synchronization Transmissions

As scheduled by the DSN, transmissions were made as tabulated in Table 2 for a total duration of 12-1/2 hours. These transmissions are made at 7149.9 MHz, using the 9-m antenna equipped with a 100-kW transmitter.

B. Viking Mission Configuration Tests, DSS 14

In support of the configuration testing at DSS 14, which is necessary in preparation for the Viking missions, we have provided on-site support to assure correct operation of the Block IV receiver/exciter, or to aid in troubleshooting in the event the system does not perform as expected. Except for some monitoring difficulties, we have supported the telemetry and command configuration testing to a successful conclusion insofar as the installed equipment will allow. A total of 88 hours of support was provided to this testing effort.

VI. In Support of Section 825

Planetary Radio Astronomy

In support of the Planetary Radio Astronomy Experiment (OSS 196-41-73-01), we observe the planet Jupiter and various radio calibration sources. Received flux density, at 2295 MHz, LCP/RCP, is measured using the 26-m antenna, the station receiver, and the NAR. Observations were made as tabulated in Table 3 and are made semi-automatically with the 26-m antenna offsets under the control of the NAR.

Table 1. Pulsars observed at DSS 13 (December 16, 1974 through February 15, 1975)

0031-07	0823+26	1706-16	2021+51
0329+54	0833-45	1749-28	2045-16
0355+54	1133+16	1818-04	2111+46
0525+21	1237+25	1911-04	2218+47
0628-28	1604-00	1929+10	
0736-40	1642-03	1933+16	

Table 2. Clock synchronization transmissions (December 16, 1974 through February 15, 1975)

Station	Number of transmissions
DSS 42	3
DSS 43	3
DSS 61	3
DSS 62	1
DSS 63	2

Table 3. Radio calibration sources observed at DSS 13 (December 16, 1974 through February 15, 1975)

3C17	3C138	3C353
3C48	3C147	PKS 0237-23
3C123	3C348	1C5146